STANDARDS CHANGES CATALOG (SCC)

SCC NUMBER: SCC #141

CHANGE PROPOSAL TITLE: Segmentation/Reassembly (S/R) Header: Bit Transmission Order Example

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ORIGINATOR'S INTERNAL NUMBER:

AFFECTED DOCUMENT: MIL-STD-188-220C

PRECEDENCE: Priority

RECOMMENDATIONS: Required for Army – Marine Corps interoperability.

RECORD OF PROCESSING

DATE:	ACTION:
03 Mar 03	Proposal
07 Mar 03	Work Item
05 May 03	R2; Draft
06 May 03	R3; Draft
15 May 03	Approved with addition of 4 octets (like SCC #140)
15 Jun 03	R4; For Final Approval
2 Jul 03	R5; Unanimously approved via email

1. STATEMENT OF THE PROBLEM: The bit order of S/R header is ambiguous. The interface between the Army's Maneuver Control System (MCS) and the Marine Corps' Command & Control Personal Computer (C2PC) has raised the issue on the proper bit order of transmission of S/R header information. The CNRWG has been very careful in the standard to show bit order in every other case to avoid ambiguity. S/R escaped notice when examples with actual values were added.

2. PROBLEM ANALYSIS: Appendix C of MIL-STD-2045-47001 describes the S/R Protocol. This is a DoD unique protocol for segmenting 47001 messages larger than maximum segment size. The header itself is shown in standard User Datagram Protocol/Internet Protocol (UDP/IP) format where the information is shown in 32 bit blocks. The intent of MIL-STD-2045-47001 is that for transmission purposes the S/R Header be treated like standard UDP/IP headers. Once the header is created it is treated as a series of octets. The octets are therefore transmitted in Network Byte Order or most significant byte first. The underlying layers dictate actual bit order. If the S/R is transmitted under MIL-STD-188-220 then the bit order is Least Significant Bit (LSB) of the octet first. Appendix G of MIL-STD-188-220C will be updated.

3. PROPOSED SOLUTION: See attached pages.

4. ALTERNATIVE SOLUTIONS: None.

5. SYSTEM CHANGES REQUIRED: None.

6. CONFIGURATION ITEM DOCUMENTATION CHANGES: MIL-STD-188-220C. Note: *If one is using S/R with MIL-STD-188-220B then the example in MIL-STD-188-220C should be used for bit order clarification.* Since MIL-STD-188-220B will not be updated, a reference stating the first sentence in the above Note will be placed on the CNRWG website and on DoD's ASSIST database in the Document Part Description for downloading the PDF file for Revision B.

7. IMPACT ON INTEROPERABILITY: Improves interoperability because the S/R header bit order was previously ambiguous.

8. IMPACT ON RELATED DOCUMENTS: None.

9. IMPLEMENTATION DATES: When approved for C2PC.

10. OTHER CONSIDERATIONS: None.

11. REFERENCES: None.

12. Trouble Reports (TRs) ADDRESSED IN THIS SCC: None.

G.3.3a An example of Segmentation / Reassembly (S/R) ~~header~~ Data Segment construction. S/R is described by MIL-STD-2045-47001~~C~~, Appendix C. The S/R ~~header~~ Data Segment from MIL-STD-2045-47001~~C~~, Appendix C, consists of ~~8~~ 12 octets as shown in Figure 59a with the example values to be used for this appendix. Since MIL-STD-2045-47001C, Appendix C, treats bit 0 as MSB, Figures 59a and 60a show B_0 as MSB. For this example, the Source Port has a value of 5000, Destination Port has a value of 1581, the Type (3 bits) equals 2, HLEN (12 bits) equals 3, P/F (1 bit) equals 1, ~~and~~ the Serial Number has a value of 16000, the Segment Number equals 260, and the Last Segment Number equals 300. MIL-STD-188-220 typically treats the LSB as bit 0.

<table>
<tr><td>MSB</td><td>LSB</td><td>MSB</td><td>LSB</td><td>MSB</td><td>LSB</td><td>MSB</td><td>LSB</td></tr>
<tr><td>0</td><td>7</td><td>8</td><td>15</td><td>16</td><td>23</td><td>~~21~~24</td><td>31</td></tr>
<tr><td colspan="4">Source Port</td><td colspan="4">Destination Port</td></tr>
<tr><td>Type</td><td colspan="2">HLEN</td><td>P/F</td><td colspan="4">Serial Number</td></tr>
<tr><td colspan="4">Segment Number</td><td colspan="4">Last Segment Number</td></tr>
<tr><td colspan="8">Data Portion</td></tr>
</table>

FIGURE 59a. S/R ~~header~~Data Segment.

Figure 60a illustrates the ~~eight~~ twelve octets comprising S/R with the binary bit patterns. Each octet is marked to show both the MSB and LSB of each octet. It demonstrates how each of the octets are arranged and passed in order to next layer.

Octet 0		**Octet 1**		**Octet 2**		**Octet 3**	
B_0	B_7	B_8	B_{15}	B_{16}	B_{23}	B_{24}	B_{31}
2^7	2^0	2^7	2^0	2^7	2^0	2^7	2^0
00010011		10001000		***0***0000110		00101101	
Source Port (5000)				**Destination Port (1581)**			

Octet 4		**Octet 5**		**Octet 6**		**Octet 7**	
B_0	B_7	B_8	B_{15}	B_{16}	B_{23}	B_{24}	B_{31}
2^7	2^0	2^7	2^0	2^7	2^0	2^7	2^0
010***0***0000		0000011***1***		***0***0111110		10000000	
Type (2) HLEN (3) P/F (1)				**Serial Number (16000)**			

Octet 8		**Octet 9**		**Octet 10**		**Octet 11**	
B_0	B_7	B_8	B_{15}	B_{16}	B_{23}	B_{24}	B_{31}
2^7	2^0	2^7	2^0	2^7	2^0	2^7	2^0
00000001		00000100		***0***0000001		00101100	
Segment Number (260)				**Last Segment Number (300)**			

FIGURE 60a. Octet representation of S/R ~~header~~Data Segment.

The construction of a S/R ~~Header~~ Data Segment is illustrated by the example in Table LXIa. The first four columns of the table provide a description of each field in both decimal and binary representations. The last two columns show the physical encoding of the S/R Layer PDU. In the fifth column, Field Fragments, the bits of each field are placed in octets. The bits(s) of each field are positioned in an octet such that the MSB of the field is positioned in the most significant unencoded bit of the octet, the next MSB of the field is placed in the next most significant unencoded bit of the octet, and repeated until all of the bits of the field have been encoded. When an octet is filled

before all the bits of a field are encoded, the process is continued encoding the next octet with the remaining bits of the field. This field/octet encoding procedure is performed starting with the first field and octet, and repeated for each successive field and individual octet, in order, until the encoding is completed. X's are used to identify bits that are not associated with the field being encoded. The sixth column, Octet Value - Binary, assembles the bits contributed by successive fields into complete octets, represented in binary. The last column, Octet Number, numbers the octets from first to last starting with 0.

TABLE LXIa. Example construction of S/R ~~header~~Data Segment.

Field Name	Length (bits)	Value (Dec)	Value (Binary)	Field Fragments	Octet Value (Binary)	Octet Number
			MSB ***2^n*** **LSB** **2^0**	**MSB** **2^7** **LSB** **2^0**	**MSB** **2^7** **LSB** **2^0**	
Source Port	16	5000	***0***0001001110001000	***0*** 0 0 1 0 0 1 1 1 0 0 0 1 0 0 0	***0*** 0 0 1 0 0 1 1 1 0 0 0 1 0 0 0	0 1
Destination Port	16	1581	***0***0000011000101101	***0*** 0 0 0 0 0 1 1 0 0 0 1 0 1 1 0 1	***0*** 0 0 0 0 0 1 1 0 0 0 1 0 1 1 0 1	2 3
Type	3	2	***0***10	***0*** 1 0 x x x x x		
~~**Type**~~ **HLEN**	~~3~~ 12	~~2~~ 3	~~***0***10~~ ***0***00000000011	~~***0*** 1 0 x x x x x~~ x x x ***0*** 0 0 0 0 0 0 0 0 0 1 1 x	***0*** 1 0 ***0*** 0 0 0 0	4
P/F	1	1	***1***	~~0 0 0 0 0 1 1 x~~ x x x x x x x ***1***	0 0 0 0 0 1 1 ***1***	5
Serial Number	16	16000	***0***0111111010000000	***0*** 0 1 1 1 1 1 0 1 0 0 0 0 0 0 0	***0*** 0 1 1 1 1 1 0 1 0 0 0 0 0 0 0	6 7
Segment Number	16	260	***0***0000001000000100	***0*** 0 0 0 0 0 0 0 1 0 0 0 0 0 1 0 0	***0*** 0 0 0 0 0 0 0 1 0 0 0 0 0 1 0 0	8 9
Last Segment Number	16	300	***0***0000001001011100	***0*** 0 0 0 0 0 0 0 1 0 0 1 0 1 1 0 0	***0*** 0 0 0 0 0 0 0 1 0 0 1 0 1 1 0 0	10 11

Table LXIIa illustrates the ~~eight~~ twelve octets of the S/R ~~Header~~ Data Segment showing the binary value of the octet, the octet number (0-~~7~~11) and the field represented by each octet. Note that the bit with the bold italicized font identifies the MSB (2^n) of the field, not the octet.

TABLE LXIIa. Octet representation of S/R header.

Octet Value (Binary)	Octet Number	Field Name
2^7 2^0		
0 0 0 1 1 0 0 1 1	0	**Source Port**
1 0 0 0 1 0 0 0	1	**Source Port**
0 0 0 0 0 1 1 0	2	**Destination Port**
0 0 1 0 1 1 0 1	3	**Destination Port**
0 1 0 ***0*** 0 0 0 0	4	**Type & HLEN**
0 0 0 0 0 1 1 ***1***	5	**HLEN & P/F**
0 0 1 1 1 1 1 0	6	**Serial Number**
1 0 0 0 0 0 0 0	7	**Serial Number**
0 0 0 0 0 0 0 0 1	8	**Segment Number**
0 0 0 0 0 1 0 0	9	**Segment Number**
0 0 0 0 0 0 0 0 1	10	**Last Segment Number**
0 0 1 0 1 1 0 0	11	**Last Segment Number**

Figure 61a provides a serial representation of the S/R header, as it would appear at the physical layer.

Octet 0	Octet 1	Octet 2	Octet 3	Octet 4	Octet 5	Octet 6	Octet 7
2^0 2^7	2^0 2^7	2^0 2^7	2^0 2^7	2^0 2^7	2^0 2^7	2^0 2^7	2^0 2^7
1 1 0 0 1 0 0 ***0***	0 0 0 1 0 0 0 1	0 1 1 0 0 0 0 ***0***	1 0 1 1 0 1 0 0	0 0 0 0 ***0*** 0 1 ***0***	***1*** 1 1 0 0 0 0 0	0 1 1 1 1 1 0 ***0***	0 0 0 0 0 0 0 1

Octet 8	Octet 9	Octet 10	Octet 11
2^0 2^7	2^0 2^7	2^0 2^7	2^0 2^7
1 0 0 0 0 0 0 ***0***	0 0 1 0 0 0 0 0	1 0 0 0 0 0 0 ***0***	0 0 1 1 0 1 0 0

FIGURE 61a. Serial representation of S/R ~~header~~Data Segment.